

CLAIMS

We claim:

1 1. A system comprising:
 2 a network having a host coupled thereto, the host executing software
 3 to generate packets for communication on the network;
 4 a bus with a bus device coupled thereto;
 5 an interface coupling the network to the bus, the interface and host
 6 coordinating to tunnel bus events over the network between the host and the
 7 bus device by encapsulating bus events into network protocols, transferring
 8 the encapsulated bus events over the network, and subsequently
 9 decapsulating the bus events to recreate the bus events.

1 2. The system defined in Claim 1 wherein the bus device
 2 generates isochronous data and the network operates asynchronously, such
 3 that isochronous data is transported over an asynchronous network.

1 3. The system defined in Claim 1 wherein the interface generates
 2 network packets that encapsulate the bus events in a network protocol
 3 portion.

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1 4. ~~The system defined in Claim 3 wherein the network protocol~~
2 portion comprises an Internet Protocol (IP) portion.

1 5. The system defined in Claim 3 wherein the network protocol
2 portion includes a header for information to recreate bus events.

1 6. The system defined in Claim 1 wherein each tunneled request
2 includes a tunneling header and a tunneling data portion, wherein the
3 tunneling data portion is specific to each tunneling packet type and
4 tunneling transaction type, and the tunneling header is common among
5 tunneling packet types.

1 7. The system defined in Claim 6 wherein the tunneling header
2 includes a field which specifies the type of packet as one of a group of
3 control packet, an information packet, or an ownership packet.

1 8. The system defined in Claim 6 wherein the tunneled packet
2 comprises an IEEE 1394 packet.

1 9. The system defined in Claim 6 wherein the tunneled packet
2 comprises a USB packet.

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1 10. The system defined in Claim 6 wherein the tunneling header
2 indicates the packet type and transaction type.

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1 11. The system defined in Claim 1 wherein the host runs an
2 application that generates packets for the bus device and relies on an
3 operating system that includes a driver for the bus device that issues the bus
4 device packets and redirects the bus device packets to a network stack that
5 encapsulates the bus device packets to create a network packet and sends
6 the network packet to a remote bus device via the interface, the interface
7 thereafter decapsulating the network packet to obtain the bus device packet
8 and forwarding the bus device packet to the bus device.

1 12. The system defined in Claim 1 wherein the bus device
2 generates bus device packets for transport to the host and sends the bus
3 device packets on the bus, the interface encapsulating the bus device packets
4 into a network packet and forwards the network packet to the host, the host
5 executing a network driver that decapsulates the network packet, identifies
6 bus device packets therein and redirects the bus device packets to a bus
7 device driver running thereon.

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1 18. The system defined in Claim 1 wherein the bus adheres to the
2 ~~Universal Bus Standard (USB).~~

1 19. A method of controlling devices across the network
2 comprising:
3 capturing bus events generated on a bus;

4 encapsulating the captured bus events into packets associated with a
5 network protocol using an interface;
6 decapsulating the capsulated bus event and recreating them at a
7 remote site transparently to a user using information in the header of the
8 packet.

1 ~~20. The method defined in Claim 19 where the remote site~~
2 comprises a similar bus and similar bus device to that which generated the
3 bus events.

1 ~~21. An apparatus for controlling devices across the network~~
2 comprising:
3 means for capturing bus events generated on a bus;
4 means for encapsulating the captured bus events into packets
5 associated with a network protocol using an interface;
6 means for decapsulating the capsulated bus event and recreating
7 them at a remote site transparently to a user using information in the header
8 of the packet.

1 ~~22. A system comprising:~~

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2 ~~an Internet Protocol (IP) Ethernet network having a host coupled~~
3 thereto, the host executing software to generate packets for communication
4 on the network;

5 a serial bus with a bus device coupled thereto, where transfers occur
6 to and from the bus device which adhere to the IEEE-1394 bus standard;

7 an interface coupling the network to the bus, the interface and host
8 coordinating to transport bus events between the host and the bus device via
9 tunneling bus events over the network by capturing and encapsulating the
10 bus events into network protocols and subsequently decapsulating the bus
11 events and recreating them.

1 23. The system defined in Claim 22 wherein the bus device
2 generates isochronous data and the network operates asynchronously, such
3 that isochronous data is transported over an asynchronous network.

1 24. The system defined in Claim 22 wherein the interface
2 generates network packets that encapsulate the bus events in a network
3 protocol portion.

1 25. The system defined in Claim 24 wherein the network protocol
2 ~~portion includes a header for information to recreate bus events.~~

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1 ~~26. The system defined in Claim 24 wherein each tunneled request~~
2 includes a tunneling header and a tunneling data portion, wherein the
3 tunneling data portion is specific to each tunneling packet type and
4 tunneling transaction type, and the tunneling header is common among
5 tunneling packet types.

1 27. The system defined in Claim 26 wherein the tunneling header
2 includes a field which specifies the type of packet as one of a group of
3 control packet, a serial bus tunneled packet, or an ownership packet.

1 28. The system defined in Claim 27 wherein the tunneled packet
2 consists of an IEEE 1394 packet.

1 29. The system defined in Claim 22 wherein the tunneling header
2 indicates the packet type and transaction type.

1 ~~30. The system defined in Claim 22 wherein the host runs an~~
2 application that generates packets for the bus device and relies on an
3 operating system that includes a driver for the bus device that issues the bus
4 device packets and redirects the bus device packets to a network stack that
5 encapsulates the bus device packets to create a network packet and sends

1 31. The system defined in Claim 22 wherein the bus device
2 generates bus device packets for transport to the host and sends the bus
3 device packets on the bus, the interface encapsulating the bus device packets
4 into a network packet and forwards the network packet to the host, the host
5 executing a network driver that de-encapsulates the network packet,
6 identifies bus device packets therein and redirects the bus device packets to
7 a bus device driver running thereon.

1 33. A system comprising:
2 an Internet Protocol (IP) Ethernet network having a host coupled
3 thereto, the host executing software to generate packets for communication
4 on the network;
5 a serial bus with a bus device coupled thereto, where transfers occur
6 to and from the bus device which adhere to the USB bus standard;

1 34. The system defined in Claim 33 wherein the bus device
2 generates isochronous data and the network operates asynchronously, such
3 that isochronous data is transported over an asynchronous network.

1 35. The system defined in Claim 33 wherein the interface
2 generates network packets that encapsulate the bus events in a network
3 protocol portion.

36. The system defined in Claim 33 wherein the tunneling header includes a field which specifies the type of packet as one of a group of control packet, a serial bus tunneled packet, or an ownership packet.

1 37. The system defined in Claim 36 wherein the tunneled packet
2 ~~consists of a USB packet.~~

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1 38. The system defined in Claim 33 wherein the host runs an
2 application that generates packets for the bus device and relies on an
3 operating system that includes a driver for the bus device that issues the bus
4 device packets and redirects the bus device packets to a network stack that
5 encapsulates the bus device packets to create a network packet and sends
6 the network packet to a remote bus device via the interface, the interface
7 thereafter decapsulating the network packet to obtain the bus device packet
8 and forwarding the bus device packet to the bus device.

1 39. The system defined in Claim 33 wherein the bus device
2 generates bus device packets for transport to the host and sends the bus
3 device packets on the bus, the interface encapsulating the bus device packets
4 into a network packet and forwards the network packet to the host, the host
5 executing a network driver that de-encapsulates the network packet,
6 identifies bus device packets therein and redirects the bus device packets to
7 a bus device driver running thereon.

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